CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

MINES BRANCH

OTTAWA

PHYSICAL METALLURGY DIVISION

TEST REPORT PM-66-2

HARDNESS EXAMINATION OF CANADIAN 5 CENT NICKEL COINS

by

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Nuclear and Powder Metallurgy Section

February, 1966

PHYSICAL METALLURGY DIVISION

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To: Mr. N.A. Parker,
Master, Royal Canadian Mint,
Sussex Drive,
Ottawa, Ontario.

Re: Hardness Examination of Canadian 5 Cent Nickel Coins.

Introduction

For information and use by the Royal Canadian Mint Committee on New Coinage, a hardness survey has been made of the Canadian 5 cent nickel coins to determine any differences between coins made from Sherritt Gordon powder nickel rolled strip and pure nickel hot rolled strip used in earlier years.

Procedure

The hardness of the Canadian 5 cent nickel coins was determined by three different methods:

1. To determine the superficial hardness (i.e., of the surface skin), two sets of coins were selected and tested using a Tukon hardness tester and a 0.5 kg load. The coins of the first group were randomly dated from 1940 to 1960 and represented conventionally - produced hot rolled pure nickel strip obtained prior to 1962. The second group, dated 1964 and 1965, represented coins produced from pure nickel strip produced by Sherritt Gordon Mines Limited via the powder metallurgy route. Hardness readings were obtained on the reverse face of each coin (beaver side) in the flat area on both sides of the beaver and below the maple leaf. Two readings were averaged for each coin.

2. The second method of testing the coins was to determine their Rockwell B hardness. This is obtained from a considerably deeper impression, approximately 14% of coin thickness. Four coins dated before 1962 and four dated in 1964 and 1965 were selected for testing. The position where the hardness impressions were made on each coin are shown in the photomicrograph in Figure 1. The size of the impressions is readily seen, their depth ranging from .007 in. to .009 in. Tukon superficial hardness impressions by comparison are invisible.

Figure 1 - Canadian 5 cent nickel coin showing Rockwell B impressions.

3. To determine any hardness differences in the cross-section of the coins, two coins, one dated 1951 and one dated 1964, were cut in half. These coins were mounted, polished and etched to remove the layer of worked metal produced from sectioning. Three rows of Tukon hardness impressions, using a 0.5 kg load, were taken at right angles to the faces of the coins at intervals of 0.06 in. across the section.

Results

Test No. 1:

The results of the superficial hardness tests of coins are shown in Table 1. The average hardness of the coins dated 1940 to 1960 was 193 DPH (Diamond Pyramid Hardness Number) and the average hardness of the coins dated 1964 and 1965 was 159 DPH.

Test No. 2:

From the Rockwell B hardness results in Table 2 it was apparent that coins made from material supplied by Sherritt Gordon are considerably softer than those produced in earlier years.

Test No. 3:

Hardnesses determined by the Tukon hardness tester on the cross-section of the coins are shown in Table 3. In addition to confirming the lower hardness of the Sherritt Gordon produced nickel product, the tests show the substantial variation in hardness of both types of nickel from one surface through the core to the other surface.

While it appears that the reverse side of the Sherritt Gordon coins was found harder than the rest of the coin, the flow of nickel in various individual locations during the coin striking process is not well established and variations from what might be expected intuitively are quite possible.

Conclusions

1. Coins produced from pure nickel of powder metallurgy origin are softer than similar coins of conventional cast and wrought origin.

2. Variations in hardness exists throughout the body of coins of both types of nickel, and, while it was impossible to obtain satisfactory readings on non-flat surfaces, it is reasonable to assume similar differences on different areas of the surface as affected by the design detail.

3. The variations in hardness are unquestionably due to the presence of more or less cold work in the structure of the pure nickel as coined, and it is evident that such cold work is distributed in varying amount over the surface and throughout the body of both types of nickel coins.

TABLE 1

Tukon Hardnesses Using 0,5 kg Load on Circulated 5 Cent Nickel Coins

Date	DPH		Av.
1940	220	196	208
1941	176	176	176
1946	186	181	184
1947	196	196	196
1947*	196	207	202
1949	181	196	188
1950	181	181	181
1956	202	186	194
1957	196	191	194
1960	196	196	196
1961	207	196	202
1964	154	154	154
1964	143	154	149
1964	172	164	168
1965	154	154	154
1965	168	168	168
*Maple Leaf			

Note: Each DPH figure is an average of 2 readings.

TABLE 2

Rockwell B Hardness of Circulated Coins

Year	R_B (average of 2 tests)
1965	34
1965	34
1964	36
1964	45
1956	50
1961	58
1956	53
1941	55

TABLE 3

Tukon Hardness on Polished and Etched Cross-Sections of 1951 and 1964 5 Cent Nickel Coins
(Distance Between Measurements was 0.06 in.)

1951 (DPH)	1964 (DPH)
Cross-Section A	
Reverse Face	Reverse Face
" 131	138
" 135	117
" 135	108
" 135	112
" 131	100
Obverse Face	Obverse Face
Cross-Section B	
Reverse Face	Reverse Face
" 135	135
" 122	122
" 122	115
" 122	115
" 122	108
Obverse Face	Obverse Face
Cross-Section C	
Reverse Face	Reverse Face
" 146	122
" 146	109
" 146	104
" 150	104
" 138	108
Obverse Face	Obverse Face

Approved:

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Nuclear and Powder Metallurgy Section.

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